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FEBRUARY 1952

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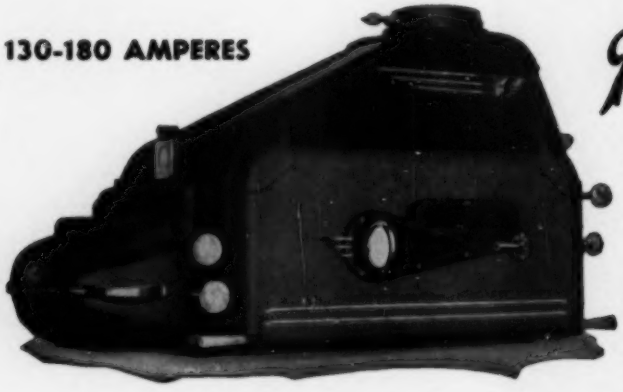

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MONTHLY CHAT

IT WOULD seem that the period of uneasy ease in terms of a guaranteed income such as the $900,000 "take" *in one year* by Charles Skouras of Fox West Coast Theaters and the annual jaunts to Florida for two, three or more weeks each winter by exhibitors who are stony-broke (you should live so long) have come to an end. Really, the producers and exhibitors are finally exhibiting some concern about the source of their power and opulence.

For months we have been hammering away in this corner on the theme of the great necessity for the motion picture industry to have an independent research organization of its own. Oh, yes, there is the SMPTE and the Research Council of the Academy and the Conservation Department of the MPAA and various and sundry other units which have to do with improvement, maintenance, conservation and the like. But these bodies have to date been concerned primarily with conserving that which we *have*. Our concern is that which we *have not but should have*.

Sounding off before the recent meeting of the Theater Owners of America in Los Angeles was the eminent Dr. Lee A. Dubridge, president of the California Institute of Technology at Palo Alto, Calif. What the motion picture industry needs, said the Doctor, was an independent research organization which would enable the motion picture theater as operated today not only to withstand but to overcome the onslaughts of home Tv and other forms of competition. About $3 million was the Doctor's estimate of the amount needed to properly launch such an enterprise.

Well, we're all for this sort of up-and-doing, as recounted in this space on innumerable occasions. But we are also all for the laying off of the research set-up and personnel by the pawing hands of those who have thus far demonstrated only that they have sticky hands. It is no secret that the so-called executive brains of the motion picture industry wouldn't recognize a Bunsen burner if their Scotch was served in it—nor even a good film story unless it were recommended by their teen-age daughter on the basis of a casual contact with some vagrant genius whom they found lolling on the sand at Cannes.

If and when the all-industry research project is launched, the foremost requisite will be that of intellectual integrity on the part of the institute's staff. Sure, the end sought will and should have a distinct commercial flavor in that the motion picture industry shall enjoy economic health. But let's not have a scientific group subject to the grim and voracious appetites of the industry brass which has already inflicted irreparable damage upon a once-great industry.

Let's pray that the industry means business this time, and that the Palo Alto project gets unlimited support from all concerned.

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VOLUME XXVII FEBRUARY 1952 NUMBER 2

An Object Lesson in Film-Cooling

By ROBERT A. MITCHELL

THE problem of keeping both the projector film-gate and the film below uncomfortably, even dangerously, high temperatures has always been with us. Over here in the dear old U. S. A., that is. But it's old-hat in the Stuttgart (Germany) Zeiss-Ikon works where the Ernemann "cold" projectors are made.

Of course, it may be said that the inception of the drive-in theater with its tremendously large screen first directed the reluctant, but serious, attention of American projection circles to this pressing matter—after considerable prodding by the projection craft, mainly in the pages of IP. But, to repeat, the heat problem still is with us, and it has whiskers down to its knees.

Remember the 35-amp low-intensity mirror arc you were using 15 or 20 years ago? It was *hotter* than the simplified high-intensity lamp you are using today! And the 100-amp straight arcs which illumined Theda Bara's hand-cranked emoting in the good old days were erupting volcanos in comparison with the largest rotating-positive, high-intensity arcs now on the market. The low-intensity arcs did not give nearly as much light as the modern high-intensity arcs, but they produced more radiant energy per watt—and most of this energy was in the form of absolutely invisible infrared radiation which produces strong heating effects whenever it impinges upon film or almost anything else.

Larger Screens; Hi-I Focus

There is another point to be considered, too. Whereas the 30-foot indoor screens of yesteryear could be counted on one's fingers and toes, the comparatively huge outdoor screens of today are numbered by the thousands.

Besides increasing the sales of tannic acid and other burn remedies to projectionists who must thread up sizzlingly hot projectors, the present situation in regard to excessive densities of power being shot through the aperture poses a difficult problem to film distributors who dislike having their prints heat-blistered and hopelessly buckled after one playing engagement.

From the audience point of view, superhigh projection causes a rapid flutter of the picture frames in the aperture, making perfect focus physically impossible. The audience point of view is always a good one to consider, because if theater movies become unpopular, we will find ourselves out of jobs.

Film-Cooling Adjuncts

All of us are aware that air blowers and water-cooled gate castings are now available for use with several American projectors. Not to mention the heat-filtering glasses. Be that as it may, a search for a projector having all these cooling means integrated by effective engineering would give us no cause to shout "eureka!"—unless, perchance, we invade the inner sanctum of some process projection studio and discover a tailor-made job created by a genius in the art of projection technology.

This is not to say that a single heat filter, or aperture blower, or water-cooled gate is not a good thing when used by itself without the others in proper coordination. Indeed, it most assuredly is. There is now not quite so much reason for investing in tannic acid or making for the projection-room door like mad whenever a sudden power failure causes a nitrate print to stop dead in its torrid tracks.

The irksome side of the matter is that all the world except America has enjoyed *all* cooling methods, superbly designed, for quite a number of years, notably in the German Ernemann models V and VIIB. And, to top it off, Ernemann produced about a year ago the Model X, which is the ultimate in cinematic Frigidaires. (Incidentally, the niceties of its operation are already included in the projectionist-training curricula of many European countries.)

Improvements of Long Standing

The Ernemann X, however, is best regarded as an *improvement* of the VIIB, which it resembles very closely, rather than as a totally new machine. It does not incorporate such needed innovations as a 5-to-1 intermittent movement coupled with a shutter giving 3 cutoffs per cycle or a curved anti-flutter gate, for example. But it *does* incorporate refinements of features which, though new to American projection practice, date back to the period 1925—1934.

Exclusive of the film-cooling features, we find in *old* Ernemann models such "modern" improvements as automatic mechanism lubrication, F:1.9 lenses, automatic emergency shutoff devices (which even controlled the port shutters); film tension pads adjustable while

the projector is running, and soundfilm reproducers attached as integral units of the picture mechanisms, *not* as separate unwieldy "heads" upon which silent-picture mechanisms are mounted, often crudely with the aid of shims.

Considering the deleterious effects of heat on film in the days of hot low-intensity arcs—which effects include film fires, naturally—it is understandable why German technologists recognized and attacked with considerable success the problem of keeping gate and film cool. German attention to this aspect of projection technology continued despite the total absence of drive-ins and despite the fact that comparatively few German theaters are large enough to warrant using high-intensity arc currents in excess of 75 amps.

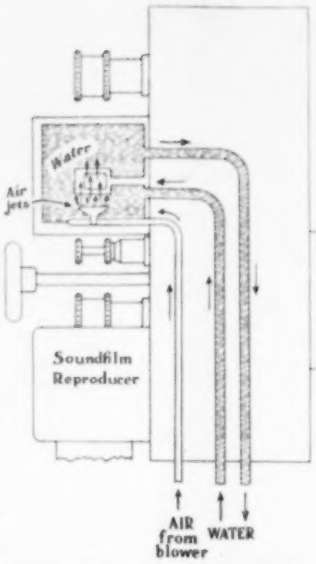
The Ernemann Cooling System

In the new Ernemann, the Model X, we find air-jets which direct controlled streams of cool air from a built-in blower at *both* sides of the film slightly below the picture aperture. The air then flows rapidly upward throughout the length of the gate, effectively blanketing the film and reducing its temperature. The air passes out at the top of the gate-enclosure.

This method of air-cooling succeeds in preventing irradiation effects such as buckling, embossing, and blistering of the darker, radiation-absorbing areas of the emulsion. The clear film-base remains relatively cold in every case with any projector, but heat conducted from the emulsion to the base may result in warped film.

It is interesting to compare the Ernemann air-cooling system with that of the Euro M2 projector. Although air is directed against the clear side of the film in the Euro by means of a tube, the emulsion side is forcibly ventilated by a rear cylindrical shutter having turbine-like vanes. The shutter enclosure provides for air intake at sides and bottom, and exhaust at the top. The Motiograph line of American projectors, beginning with the Model H, also uses a similar effective system of air cooling.

The cylindrical rear shutter of the Ernemann X also generates air currents, but these are directed into the middle section of the mechanism housing and drawn upward with considerable force by an exhaust centrifuge positioned at the top of the machine at the back side of the upper magazine. The mechanism itself therefore remains cold, regardless of the arc amperage used.



Diagrammatic representation of air- and water-cooling system of the Ernemann projector. The air exhaust-centrifuge for mechanical cooling is not shown.

Water-Cooling also Used

In addition to air cooling, the Ernemann X (like the VIIB and the V) employs the most effective mode of water-cooling known. The entire gate casting is hollow, and cold tap water continuously conducted through it. The hottest arc produces no significant rise in the temperature of the metal parts of the gate. All water tubes, being integral components of the machine, are completely concealed inside the mechanism and base.

The water, after completing its circuit through the gate casting, passes out with its absorbed heat on its way to the drain. Only simple plumbing is involved, no more complex than that required for an ordinary wash basin. A cold film gate and track rails are absolutely necessary to minimize the fire hazard with nitrate film showings, to prevent film from warping and becoming brittle through gradual dehydration, and to make the projection room, if not exactly a sylvan bower, at least a comfortable place in which to work.

The Ernemann design refutes the oft-made assertion that conduction of heat from the film-track runners of the gate to the film is of trifling importance. It is recognition of the approximately equal importance of the two types of heating effect, irradiation **and conduction**, and of relationship between the two.

Irradiation and Conduction

(1) Direct irradiation of the film by the arc-lamp beam, capable of causing embossing, permanent buckling, out-of-focus effects due to movements of the film photographs in the aperture during the flashing periods, and, in extreme cases, surface blistering in the darker portions of the emulsion.

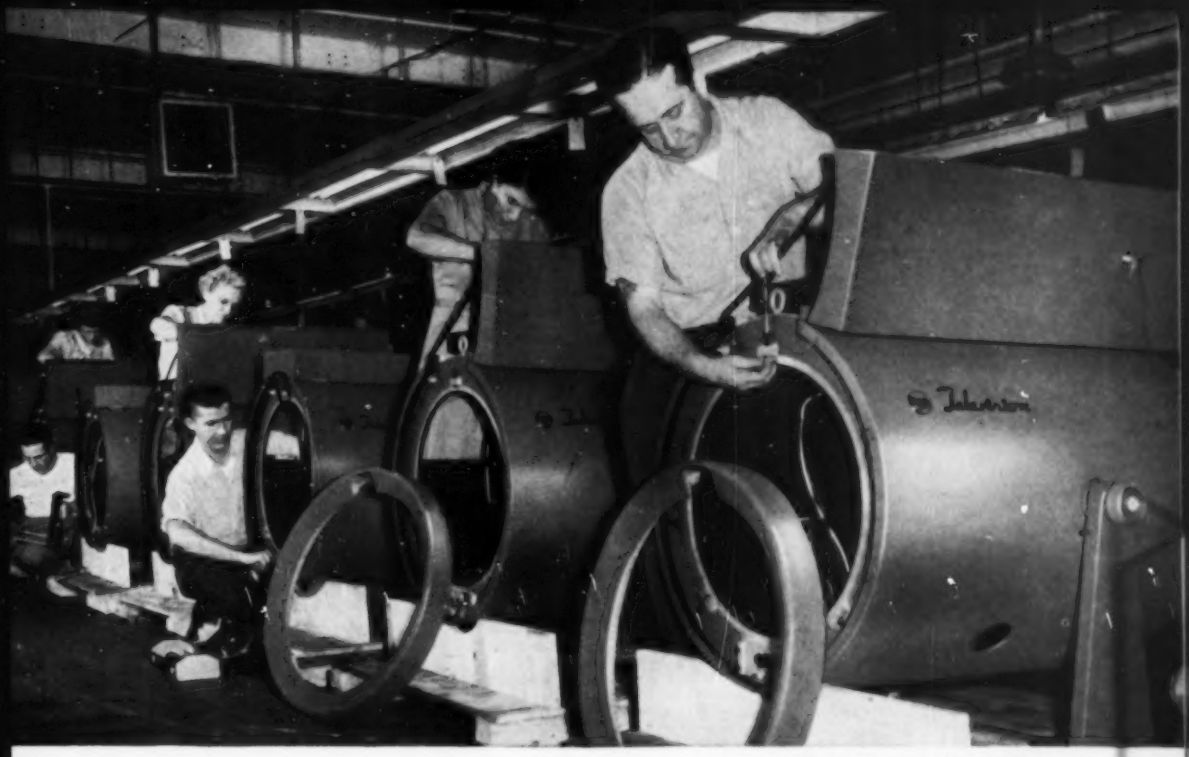
Irradiation heating is combatted by air-cooling the film in the gate and, much less effectively, by the use of filter glasses, such as Jena BG-17 and special phosphosilicate glasses. Quartz plates are very expensive and not nearly so effective as heat filters.

(2) Conductive heating. That the conduction of heat from hot film runners, tension shoes, *etc.*, is a mighty important factor is proved by the fact that the temperature of the film winding up in the lower magazine is roughly directly proportional to the temperature of the heated metal parts through which the film must pass. Thus the film issuing from a projector just started up is cool or barely warm *even though irradiation is at normal level*, but gradually gets

(Continued on page 23)

PROJECTION CHART: How to Determine Correct Screen Size for Various Projectors. Radiant Mfg. Corp., Chicago, Ill.

16 mm Sound and Silent		PROJECTOR TO SCREEN DISTANCE															
Lens Focal Length	Screen Size	8'	10'	12'	15'	20'	25'	30'	35'	40'	45'	50'	60'	75'	100'	125'	150'
1"		30"x40"	37"x50"	45"x60"	52"x70"	70"x94"	8'x10'	9'x12'	11'x14'	12'x16'	13'6"x18'	15'x20'					
1½"				30"x40"	37"x50"	45"x60"	63"x84"	70"x94"	7'x 9'	8'x10'	9'x12'	9'x12'	12'x16'	15'x20'			
2"					30"x40"	37"x50"	45"x60"	52"x70"	63"x84"	70"x94"	7'x 9'	8'x10'	9'x12'	11'x14'	15'x20'		
2½"						30"x40"	37"x50"	45"x60"	52"x70"	63"x84"	63"x84"	6'x 8'	7'x 9'	9'x12'	12'x16'	15'x20'	
3"							30"x40"	37"x50"	37"x50"	45"x60"	52"x70"	63"x84"	6'x 8'	8'x10'	12'x16'	12'x16'	15'x20'
3½"								30"x40"	37"x50"	37"x50"	45"x60"	52"x70"	63"x84"	6'x 8'	9'x12'	12'x16'	12'x16'
4"									30"x40"	37"x50"	37"x50"	45"x60"	52"x70"	63"x84"	8'x10'	9'x12'	12'x16'



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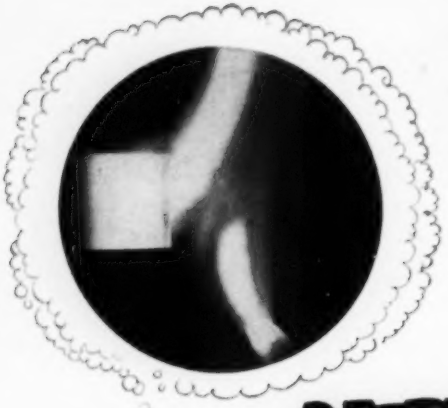

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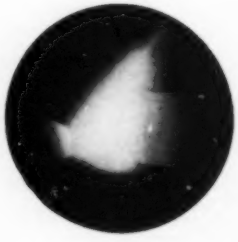

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Stereoscopic Motion Pictures

By J. A. NORLING

President, Loucks & Norling Studios, Inc., New York

Supplementing the article of the same title which appeared in IP for Aug., 1951 (p. 12) (and to be regarded as the second installment thereof) is the appended extension of remarks as they appeared in the *Journal* of the Photographic Society of America (Jan. 1952, p. 19). In the interest of greater clarity and balance, several paragraphs from the aforementioned IP article are repeated herein. Widely recognized as an authority on the stereo art, the author's stature is further enhanced by this presentation.

FROM time to time, the alternate projection of the members of a stereo pair has also been proposed. In this system, the right-eye image, for instance, is projected first, then the shutter interrupts the light beam while the film moves down to position the left-eye image. (Fig. 1). Thus there are periods of flicker that occur at different times for each eye.

If we break this sequence of events down, we find that the first light period has a value of 12.5% of the complete picture cycle. The flicker blade on the projector shutter (considering a two-bladed shutter) gives a dark period lasting 12.5%, to be followed by a light period of the same, then a long dark period consuming 62.5% for pull-down and eclipse to permit the other eye to see its image.

If standard sound-film speed of 24 frames a second is used, the resulting flicker is very annoying. Stepping up the projection to 48 frames a second increases flicker frequency twice, but it still is noticeable. There is a physiological effect that is likely to become disagreeably apparent — usually headache or nausea—after a few minutes of viewing pictures projected in this way. A complete period of darkness for one eye, while light reaches the other, will probably always result in visual fatigue, if not in nausea, no matter how high, within workable limits, the flicker frequency is brought.

Perception of Flicker

Flicker of low frequency calls for traction on the control muscles of the irises when bright light enters one or both eyes. The rapid occurence of the transmission of stimuli, first from one eye, then from the other, and the motor messages from the brain to the muscles, delivered in rapid sequence, probably accounts, in part, for the visual discomfort experienced by most people when viewing "eclipse" stereoscopic movies.

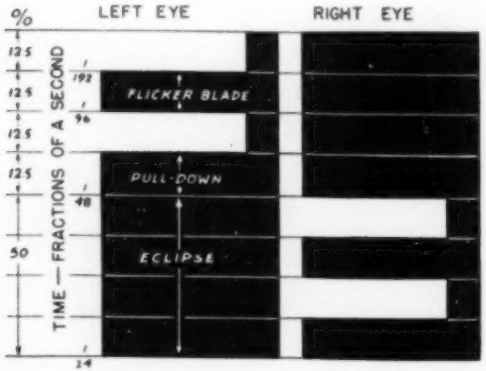
Perception of flicker depends upon the intensity of the interrupted light, as well as the flicker frequency. The more intense the light, the higher the frequency must go before flicker fusion is attained. Also, the larger the angular field over which flicker is distributed, the greater the consciousness of flicker. Hence, the dimmer the picture and the smaller it is, the lower becomes the flicker fusion frequency.

There are two ways to project and view eclipse sterograms. One is by using rotating or vibrating shutter devices held up in front of the eyes. These are synchronized electrically with the projector. The other method is to employ a rotating polarizer in front of the projector lens and polarizing spectacles for the viewer (Fig. 2). In one position the polarizer delivers light through the left spectacle filter; in the other through the right filter.

Eclipse Projection System

Alternate frame, or eclipse, projection should have at least twice the number of frames required for conventional films. That means doubling the length and providing for faster projection speed. If the alternate frames are photographed alternately, there is a very objectionable fringing in pictures of moving objects. This is a cause of eyestrain, especially in a picture when the action seen by one eye is in quite a different stage of progress than the action seen by the other. Difficulty in fusion invariably results.

This combination of disturbing effects caused by flickers out of phase between the eyes and by fusion trouble



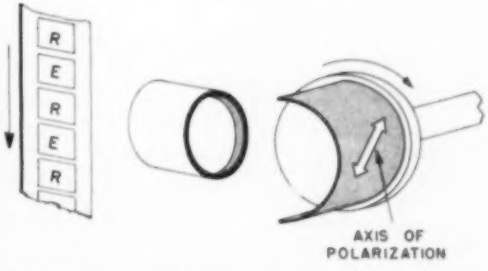


FIG. 1 (left): The light and the dark periods in "eclipse" stereoscopic projection.

FIG. 2 (above): Diagram of the "rotating polarizer" method of alternate-frame stereoscopic projection.

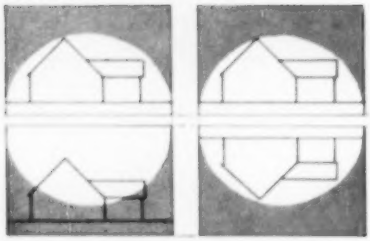


FIGURE 3

Illustrating the distribution of light over a pair of images. Left: As in an arrangement wherein both images have the same position. Right: As in an arrangement wherein one image is "flipped over" in relation to the other.

limits the appreciation of the eclipse method.

Complete visual comfort can be attained in stereo movies only if the two images are projected simultaneously, if they are rock-steady, if they are of equal brightness, if they are of equal contrast, if they are properly aligned vertically and horizontally, if far distant points are not separated too far in one image from that of the other, and if they are of exactly the same size.

Improved Single-Film Methods

Several inventions by the writer eliminate the drawback of the single-film dual-image arrangement, namely the unequal distribution of light. These methods employ novel optical systems which are accessory attachments to standard projector heads.

If one member of a stereogram has even a slightly different brightness, some eyestrain will result. If the difference is large, the resulting eyestrain will be great. This is because the action of the eyes' iris diaphragms is entirely automatic and not by voluntary control. If strong light falls on one eye, both pupils will contract and the eye seeing the darker image will have its pupil closed down more than it should be properly to see the image. In accommodation, too, both eyes act together and it is impossible for one independently to accommodate to a different extent from the other.

The improved single-film methods satisfy one of the basic requirements for good stereograms, easy to look at, in that both members of the pair are of the same brightness. Fig. 3 shows a pair of pictures having image attitudes in a conventional arrangement. It affords the best possible distribution of the light from the projector arc.

Area Light Distribution

The illuminating spot from the arc is considerably more intense in its center than in its outer regions. With images having the attitudes shown in the left-side diagram, more light falls at the top of one picture than at the top of the other, resulting in a different level of illumination in an area of one than in the corresponding area of the other. The arrangement shown on the right provides equal illumination in corresponding areas, because all portions of the light spot fall upon the same corresponding areas in each number. This meets the requirement that there be equal brightness for each image in order to attain complete visual comfort.

It may seem surprising that the intensity difference between center and edges of the light circle is significant. Actually, in practice, projection engineers are quite happy if there is only a 40% loss—60% as much light at the edges as in the center. In many theatre installations, the fall-off is as much as 50%.

The projection end of this system, using standard projector heads, has two optical trains contacting prisms as well as lenses (Fig. 4). These components are arranged so that the light beam centers and exits normal to the prism surfaces and there is no displacement or distortion such as would take place with wedge prisms. Alignment of the images on the screen is effected by a micrometer control to shift the lenses.

In the lower optical train, transmitting the right eye image (the one having the conventional attitude), the image passes through in the conventional manner, reversing to "heads up" in the projection lens. In the upper optical train transmitting the left eye image (the one having the "flipped over" attitude) the image is brought to conventional attitude in a pentaprism and right-angle prism forward of the lens. The polarizers are placed in front of the lenses away from the intense heat.

Prints for this system of projection are not made directly from the original negatives. Duplicate negatives produced in an optical duplicating process are used instead (Fig 5).

Other Single-Film Methods

Another improved single-film method has the images turned on their sides (Fig. 6). This arrangement provides for the use of the full standard aperture in case the pair of images is to occupy only

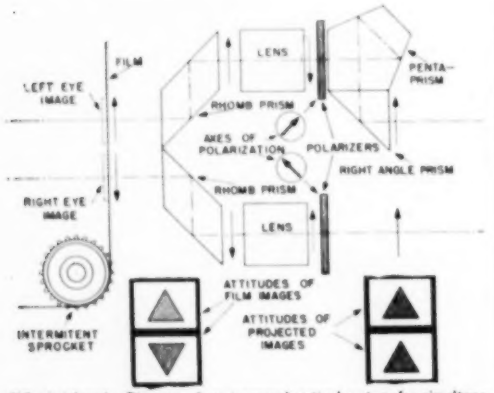


FIG. 4 (above): Diagram of an improved optical system for simultaneous projection of the two images comprising the stereoscopic pair.

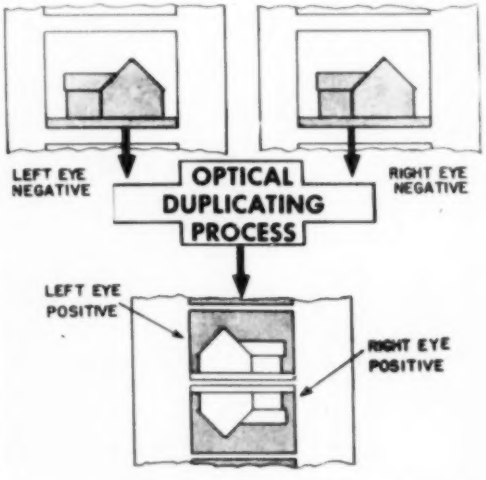


FIG. 5 (right): Diagram of transfer of images from the two negative films for the single-film carrying the two disparate images.

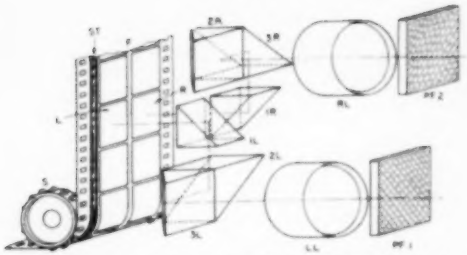


FIG. 6. Diagram of improved single-film method with the images turned on their sides.

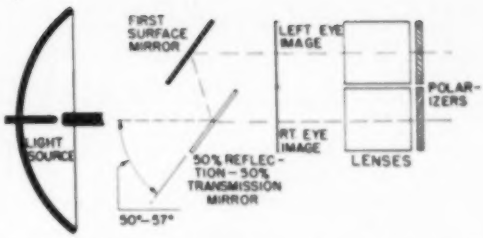


FIG. 7. Showing an arrangement that provides equal illumination for both images by using a partially transmitting mirror.

one standard frame. A series of prism elements between the film and the lens turns these images 90°. The inverted image is "flipped over" in the penta-prism and right angle prism in front of the lens. Otherwise, the practical advantages of this variation are comparable to those of the method which is discussed in the preceding few paragraphs.

Another method, devised by the author, for attaining equal illumination for both members of the stereoscopic pair is shown in Fig. 7. Here, there are two mirrors arranged between the light source and the film. The lower mirror is a transmission-reflection type, with a reflective coating that will reflect half the light to the upper mirror, one-half the light passing through to one member of the pair. The upper mirror reflects one-half the original light beam to the other member. Again, two projection lenses are used, as in the other system with the polarizers in front of them.

In this system the images do *not* have to be inverted in relation to each other, since the illuminating circle falls upon the same corresponding area in each. The light-circle can be reduced in size to fit the area occupied by one frame, adding efficiency. Added efficiency also results from the reduction in the number of glass-to-air surfaces. Additionally, there is less possibility for dirt or "fogging" on the optical elements. In contradistinction to the other methods, which require no lamphouse changes, this method does require a few changes in the lamphouse to accommodate the two mirrors.

A dual-image, single film does not add significantly to print costs, to the costs of studio production, to shipping and handling costs between exchange and theatre, nor does it require dual projectors and added labor costs for projection. This single-projection method does not introduce the unwanted possibility of images out of synchronism with each other, a hazard that exists in dual projection. It assures precise registration, one image with the other. Alignment is no problem, since both images are framed together by the same frame-setting lever. There can be no jiggling or jittering between the images such as is present in any dual system, no matter how well made the projector mechanisms.

Other Stereoscopic Methods

The first stereoscopic motion picture was made by William Friese-Greene who patented his process in 1893. He used two negative films, one behind each lens. The positive images were projected side by side on a screen and viewed through a cumbersome stereoscope permitting each eye to see only the picture intended for it. The complexity of this system barred it from any commercial application.

The grid system has been frequently proposed and a large number of variations on the basic method have been suggested during the past 40 years (Fig. 8).

Basically, the grid system employs a screen containing a large number of vertically placed parallel opaque bars forming a grating having open or transparent spaces between them. This grid is placed some distance in front of the projection screen, the grating in the grid being designed so that the right eye sees only that portion of the screen on which the picture record for the right eye appears, the bars in the grating hiding the left-eye image from the right eye. It does the same thing for the other eye.

The chief problem in using the grid system is that the observer's viewing distance, angle of view, and of eye placement in relation to the grid are of a fixed interlocking relationship. Disturb one of the three and proper viewing fails. A slight shift to the right or left results in the breakdown of "correct individual seeing" for each eye, and a double image becomes apparent, or else a pseudoscopic effect results.

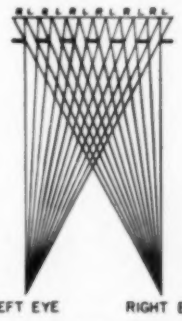


FIG. 8. Diagram of the fundamental "grid system" of stereoscopy.

Improvements have been made on the basic grid system, but serious shortcomings still remain as an intrinsic part thereof. This particularly applies to the loss of light. While a light loss is common to all stereo projection systems, it is particularly severe in this one, due to the fact that the opaque areas in the grating have to be (in most cases) about three times that of the open areas in order to keep the images from overlapping.

Another matter that must be given consideration is the appearance of the grating to the observer. The dark bars and light spaces should be small enough to be virtually invisible as a banded pattern. To make the grating lines invisible, the spacing of the elements should be no larger than about 1/3400 of the viewing distance.

We shall call the grating space G_s.

Then $$G_s = \frac{D_v}{3500} \text{ (or more)}$$

Where D_v is the viewing distance.

Thus, if $D_v = 60''$, $G_s = .0175''$, approx.

And if $D_v = 120''$, $G_s = .035''$, etc.

The distance, d_g, of any selected grating in front of the screen depends on the relationship of the distance D_v to d_g, or by the relationship of 1 to D_v.

With the usual grid system, the picture through the grating is viewed by converging the eyes at or near the grating, forming an angle. In order for the grating effectively to select the images properly for the eyes, the disparate members of the stereoscopic pair must be projected through the grating at the same angle.

[TO BE CONTINUED]
(See "Natural Vision" item on p. 22)

From the Production Front

Filming 'Quo Vadis' in Italy

A recounting of some of the technical problems that beset the camera crew in filming the biggest U. S. production ever made in a foreign country, as reported in *American Cinematographer* (Oct. and Nov. issues, 1951). A technological masterpiece.

By ROBERT L. SURTEES, A.S.C.

II.

BY THE end of the ensuing fourth day, we began to see the end of our troubles; by six p.m. we had 14 set-ups in the bag. From this time on, things went smoothly in the technical end, and we breathed easier.

Once the idea of this great picture began to impress itself in the minds of all taking part in its production, there seemed to be an almost super-human effort to assure its completion as well as to ease the way for those responsible for the important phases of its making. The religious aspect of the story did a great deal to engender this feeling.

Daily 'Takes' to London

Our daily takes were sent to the Technicolor Laboratory in London, where two prints of the results were made up. One print was sent to us in Rome, and the other to Hollywood. The lab results were wonderful, and the prompt service enabled us to pick up any retakes and added shots without undue delay.

The standard basis for exposure of Technicolor film, established by Technicolor's London Lab, is 750 foot-candles at a stop of T-1.2. The new low-level Technicolor film was not yet available to us, so we used the standard Technicolor film throughout. During the production shooting, we varied our exposure according to the screen effect desired. In order to gain depth of focus in several sequences we worked with light as high as 5,000 foot-candles. During the extreme light effect for the scene depicting the death of Nero, we worked at a light level of only 150 foot-candles.

Always keeping in mind the beauty of the costumes designed so magnificently by Herschel McCoy, I planned our camera set-ups with the idea of letting costume colors and the simplicity of Horning's sets carry the photography. Never was the lighting allowed to intrude.

Looking down on the big set of Emperor Nero's throne room for MGM's "Quo Vadis," filmed in Technicolor in Italy. Unusual overall lighting of the scene was achieved through use of huge diffusion silks and arc-light high above the set.

Warm, Rich Light Level

Because I felt that the entire film should be on the warm, rich side, all backlights were filtered slightly amber. This idea was carried throughout the picture, but at no time did the lighting on the colorful costumes and sets fall below the color temperature level required to render faithful reproduction on the screen. This is not to say that we "flat-lighted" everything. Perfect color rendition can be secured even in extreme effect shots if light units are used on principal set objects such as draperies, *etc.*—and providing light is kept from splashing over on other parts of the set.

350 Foot-Candles Level

In the set of Nero's Throne Room, we strived to get an almost shadowless effect. This entailed hanging 50-foot square silks on one side of the set, from behind which we projected light from arcs. This gave us a soft illumination of 550 foot candles over the entire set. The result was an almost third-dimensional effect on costumes, players, and other objects within the scene.

As the picture progressed, the style of lighting was changed to meet the changing pace or mood of the picture. In filming all the interiors during the burning of Rome sequence, an effort was made to keep all highlights and "kickers" on the copper-toned side.

Photographic Climax Achieved

For the sequence after the fire, sets were lighted entirely from the floor in order to achieve the dull, foreboding effect called for in the script. Then, as the time of Nero's death approaches, we began to start the real effect lighting. This was done in a progressive manner, becoming more and more effective until, during the Nero death scene, we actually achieved a photographic climax, too.

Generally speaking, the lighting of "Quo Vadis" was kept very simple. We tried to maintain a classic style, for any other type lighting on the settings of Roman villas, baths, *etc.*, with their many columns and straight-line architecture, would have been in bad taste. Always, we strived to keep the camera and the lighting from "running away" with or stealing the scene.

William Skall, A.S.C., photographed, and Tony Mann directed the night scenes of the burning of Rome. For 24 nights they worked in the burning streets, among the thousand of screaming extras. It was a difficult assignment, and ex-

(*Continued on page 29*)

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Heat-Transmitting Mirror

Radiant energy incident upon a glass plate can be divided into transmitted and reflected bands by the interference effect in thin films of dielectrics deposited on the glass. The mirror described here* reflects more than 95% of incident visible light and transmits a large part of the energy beyond 7000 A. Such mirrors have been produced; typical transmission characteristics are shown. Several arrangements for use of such a mirror with a carbon arc are also shown. See elsewhere herein pertinent relative statements.

By G. L. DIMMICK and M. E. WIDDOP

THE problem of producing "cold light" has occupied the attention of scientists and engineers for many years. A number of methods have been successfully employed for reducing the relative amount of radiant energy which lies outside the visible spectrum. One approach to the problem is to employ a light source which radiates a large portion of its energy in the visible spectrum.

The fluorescent lamp and the mercury-vapor lamp are examples of this type of source. Unfortunately, the unit brightness of the fluorescent lamp is too low to have much application in optical systems of the projection type. Fluorescent lamps are, however, used extensively for general lighting where the area of the source can be relatively large.

Spectral Deficiencies

High-pressure mercury-vapor lamps are capable of producing large values of brightness, but they are deficient in red energy, and a large part of their radiation is concentrated in a number of discrete lines. The addition of cadmium vapor into a mercury-vapor lamp greatly improves the distribution of energy in the visible spectrum and makes this type of lamp a potential competitor to the carbon-arc and the incandescent lamp for application in projection-type optical systems.

Other Avenues of Approach

Another approach to the problem is to employ a carbon-arc or incandescent light source and to remove as much of the infrared energy as possible with the aid of absorption filters or with heat-reflecting mirrors.

Absorption filters may be made of special heat-absorbing glass or they may be cells covered on both sides with ordinary glass and having a liquid, such as water, flowing continuously through them. The heat-absorbing glass filters usually require a current of air to flow past the two surfaces to carry away the heat.

A well-known type of heat-reflecting mirror is produced by evaporating a thin film of gold onto one surface of a plate of glass. The thickness of the gold may be such that its transmission is maximum for green light and its reflectivity is high in the infrared region of the spectrum. Heat-reflecting mirrors of this type have a very limited application because the transmitted light is peaked in the green and the transmitting efficiency is low even at its peak.

Interference in Thin Films

Still another approach to the problem is to use the principle of interference in thin films to build up the reflectivity for light within the visible spectrum and to permit the infrared energy to be transmitted. It is toward this solution to the problem that this article directed.

The use of multiple films for the production of dichroic mirrors has been covered in the literature. It is sufficient to say that efficient dichroic mirrors may be made by evaporating on glass alternate layers of two transparent dielectric materials, one of which has a relatively high index of refraction while the other has a lower index of refraction. The thickness of each layer is usually made to be one-quarter ($\frac{1}{4}$) wavelength for light of the color which is to be reflected.

It is possible to make dichroic mirrors which reflect as much as 95% of the light of one color and transmit 90% or more of the light of another color. A typical curve for a dichroic reflector is shown in Fig. 1. The peak reflection occurs at about 450 mμ while the peak transmission occurs at about 650 mμ.

Dichroic Reflector Advantages

One of the important characteristics of a dichroic reflector is that the absorption of visible and infrared radiation can be made negligibly small. This means that radiation which is not reflected from the multilayer film is freely transmitted through this film. It was this property which gave the authors the idea for a heat-transmitting mirror which would reflect efficiently only in the visible portion of the spectrum.

The idea was to deposit several sets of multilayer dichroic films on the surface of a plate of glass. Each set would be so controlled as to cause its peak reflection to occur at a different wavelength. The peaks would be equally spaced through the visible spectrum so that all portions of this spectrum would be reflected efficiently. Light which did not reflect from the outermost dichroic film would pass through this film to one of the inner films, where it would be reflected and would then pass back through the outer films to the surface.

The first test of the idea was made several years ago by RCA. Two sets of dichroic films were deposited in succession on the surface of a plate of glass. The thickness of the layers of one set was so controlled as to make the peak in reflectivity occur at 490 mμ. The other set of layers was made to have its peak reflectivity at 650 mμ. The transmission curve of the completed mirror is shown in Fig. 2.

Steady Advances Registered

As expected, a curve with a double hump was produced by the aforementioned procedure and the efficiency of the reflector was greatly improved. The results of the first tests were so encouraging as to warrant a systematic study of the different parameters upon which the overall effectiveness of heat-trans-

* J. Soc. Mot. Pict. & Tv Engineering for Jan., 1952.

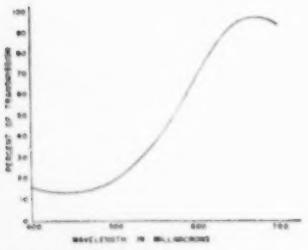


FIG. 1. Transmission curve of a typical dichroic.

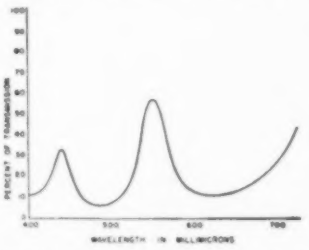
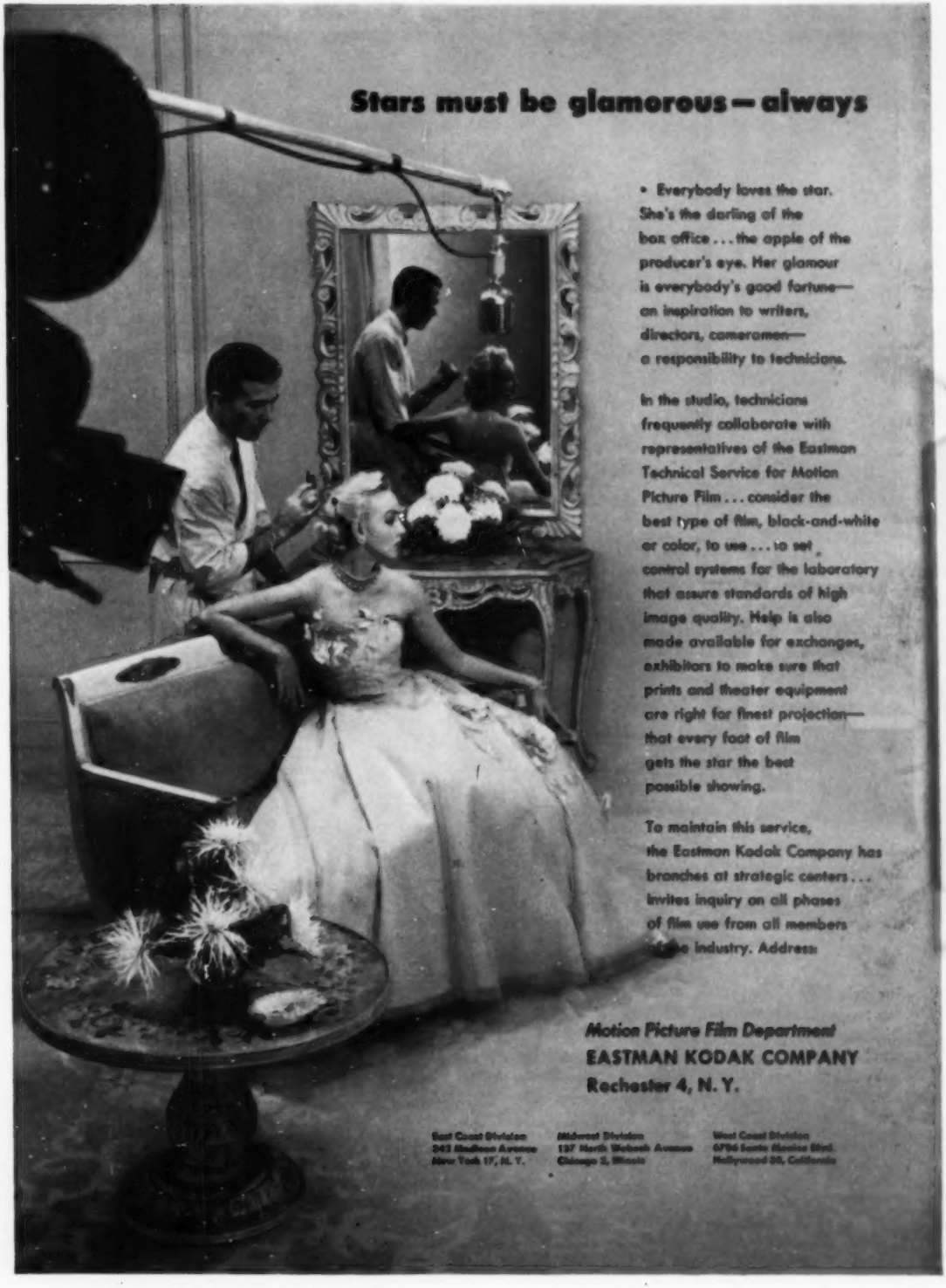


FIG. 2. Transmission curve of dichroic consisting of two sets of layers.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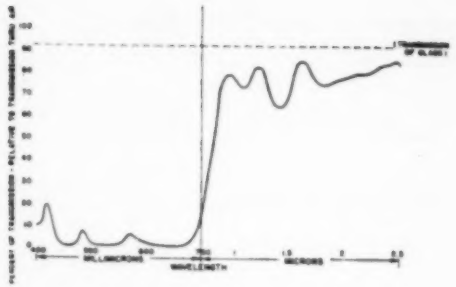


FIGURE 3

Transmission characteristics of a heat-transmitting mirror.

mitting mirror is based. Development work on this project continued intermittently for several years. The improvements which were made resulted in mirrors having a degree of reflectivity which is greater than that of a back-silvered glass mirror.

The curve in Fig. 3 shows the transmission of one of the improved designs as a function of wavelength. It will be observed that the average transmission from 400 to 700 mμ is less than 10%. Since there is no appreciable absorption, this means that the average reflectivity over the visible spectrum is more than 90%. Beyond 700 mμ, the transmission rises rapidly. The average transmission between 700 mμ and 2.5 μ is about 80%.

Transmission Characteristics

Since most of the energy from a high-intensity carbon arc is below 2.5 μ, the transmission characteristics of the heat-transmitting mirror beyond that wavelength are not shown in Fig. 3. However, the transmission has been measured out to 8 μ, and shows a sharp drop just beyond 2.5 μ. The average transmission between 2.75 and 4.25 μ is about 50%. Beyond 4.25 there is another sharp drop and the transmission from 5.25 to 8 μ is about 1%.

The first drop in transmission is characteristic of absorption due to water vapor, and the second is characteristic of absorption of glass. It is unlikely that there is appreciable reflection by interference at this part of the spectrum, since the deposited films are thin in comparison to the wavelength.

Liquid-Cell Application

The effectiveness of the heat-transmitting mirror was determined by measurements made with the arrangement shown in Fig. 4. A beam of radiant energy from a high-intensity arc lamp, *A*, was directed toward the heat-transmitting mirror, *B*, placed at an angle of 45° with the axis of the beam. A portion of the energy passed through the mirror and was absorbed by a black solution in the liquid cell *C*. The remainder of the energy was reflected from the mirror, *B*, and was absorbed by a black solution in liquid cell, *D*.

The liquid-cells were identical in size and each contained the same amount of a mixture of water and India ink. An accurate thermometer was placed in each cell and the liquid was allowed to come to room temperature before turning the arclamp on. The arclamp was started and allowed to stabilize, after which the shutter was opened.

The liquid in both cells was stirred constantly and temperature readings were taken once each minute for ten minutes. The temperature readings from both cells were plotted against time, and a smooth curve was drawn through the points. Straight lines were drawn tangent to each of these curves at the starting point, where the liquid was at room temperature.

The slope of each of the straight lines is proportional to the rate of absorption of energy. The ratio of the two slopes is, therefore, a measure of the ratio of the total energy reflected from the mirror to the total energy transmitted through the mirror. In the case of the high-intensity arc the aforementioned measurement revealed that 46% of the total energy was transmitted, while 54% was reflected. Another measurement made with a 750-watt incandescent lamp as a source revealed that 75% of the total energy was transmitted, while 25% was reflected. These measurements were made with the mirror at 45° for convenience.

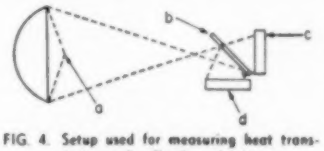


FIG. 4. Setup used for measuring heat transmission and reflection of mirror.

A test was made to determine the change in transmitted energy when the position of the mirror was shifted from 45° to normal-to-the-beam. There was no significant change.

Distribution of Energy

The energy reflected from the mirror may be divided into two parts. The first part is due to the useful visible light between the limits of 400 and 700 mμ. The second part is the unwanted infrared energy which the mirror fails to transmit.

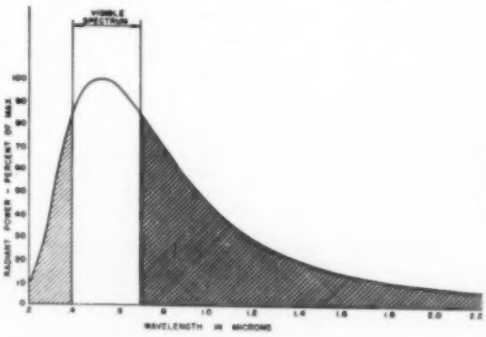


FIGURE 5

Radiant power vs. wavelength for black-body operating at 5500 K.

The first value can be obtained from a curve of radiant power versus wavelength for the light source operating at a temperature of 5500 K. This is the approximate color temperature of a high-intensity carbon arc of the type used for motion picture projection.

By measuring the area under the whole curve in Fig. 5 and comparing this with the area under the visible portion only, it is found that about 35% of the total energy from a high-intensity arc is radiated within the *visible* spectrum.

Using this value, together with the previously obtained values of total reflected and transmitted energy, we can easily determine the overall performance of the heat-transmitting mirror. This is shown by means of a chart (Fig. 6). From this it may be seen that the mirror

(*Continued on page 27*)

Illumined Screen Surround? *No;* Rounded Masking Corners? *Yes*

By ROBERT A. MITCHELL

Regrettably, an excerpt from a letter by Mr. Mitchell, intended solely for a reference data file, was inadvertently put in type and published under the heading "To Mask — or Unmask" on page 16 of the last issue of IP (January). Because this relatively informal presentation did not adequately express his views, Mr. Mitchell asked that the appended over-all summary be published forthwith.

IN THE January issue of IP there appeared a portion of a private communication of mine regarding maskless screens, together with a commentary thereon by Messrs. Schlanger and Hoffberg, originators of the "winged" type of surround illuminated by the projected picture, itself. Much as I respect the opinions of these industrious gentlemen —rest assured that I wish them every success with their setup—I must, in the interests of the dramatic and pictorial quality of the theater motion picture, take issue with them.

First, the number of Schlanger screens now in use is much too small to permit anyone to rate this screen on the basis of chance patron remarks and lobby questioning. In short, the Schlanger screen is too unimportant, as yet, because most persons in the group which is responsible for the main volume of box-office dollars have never seen a show projected on the Schlanger surrounded screen. When 100 "average" theaters—not "class" houses alone—have thus been fitted, we will be willing to listen to those who have a commercial interest in the Schlanger screen.

Maskless Screen Acceptance Scouted

Undoubtedly, my rather abbreviated and seemingly arbitrary statement that "such surrounds are preferred by a *minority* of moviegoers," puzzled Schlanger. Unfortunately, I did not know that I was writing for publication. What I meant was this: I am positively convinced that the movie public, by and large, is interested only in the picture on the screen, the excellence of its story, direction, acting, photography, sound, *etc.*, and the professional smoothness of its projection.

This conviction stems from unfortunate experiences with color and lighting effects on side drapes, *etc.*,—effects which went over big with sophisticated audiences but which fell flat on their face in the "average" neighborhood-type theater. As a projectionist I am very much the slave of the preferences of audiences, just as the exhibitor (and I have had working experience in *that* field, too) will book nothing but grade B westerns if that is the type of picture his patrons want—even though he, himself, cannot bear to sit through even one of them.

As a result of my experiences, and by trial and error (my mistakes have been many) I have learned that the average audience absolutely refuses to tolerate distractions, no matter how visually pleasing they may be from a purely esthetic viewpoint. I have devoted years of thought to the matter of screen masking to find the system which minimizes extraneous effects as much as possible. One of these enemies of satisfactory projection is the square-cornered black masking setup.

Favors Rounded Screen Corners

I subscribe wholeheartedly to the Schlanger statement that "black masking" draws such comments as "morbid —boxed-in—looks like a picture on a wall," providing that the standard type of masking used in the majority of our theaters is meant. By experimentation I have found that *rounded* corners solve the problem satisfactorily. Black masking having rounded screen corners exerts definite effects on the patron, such as:

1. No distracting sharp corners.
2. Nothing before the patron's eyes except the picture alone; and it is the *picture* he pays to see.
3. Tendency to focus attention at center of screen, where significant action takes place in most scenes, as planned by the cameraman.
4. The cameraman's work gets a more advantageous display.
5. Because of the absence of all points and sources of distraction of a visual nature, the boundaries of the picture seem to "melt" to give a picture area of indeterminate shape and size; that is, the patron becomes more quickly absorbed into the drama of the film and loses consciousness of surroundings and picture edges, even though the edges are sharp.
6. Decrease of the inherent "flatness" of the 2-dimensional picture. By this I mean that while no stereoscopic effects are produced, the patron "forgets" that the picture is flat.
7. Retention of standard motion-picture format undistorted by the simultaneous-contrast effects induced by all types of illuminated screen surrounds.
8. The appearance of increased picture brightness and uniformity of illumination.

No "picture-frame" effect by means of the elimination of masking and the absence of the conventional proscenium opening is shown here, one of the early contributions of Ben Schlanger, the modern-minded architect. Convergence of the forward side walls, only a little wider than the screen itself, positions the screen image in a "natural" field of self-created light.

There is nothing new about the round-cornered screen, of course. In fact, it's as old as the movies. But I see it as a good thing, have made and am making efforts to revive it in the best interests of theater motion pictures. I am sure that the Schlanger people would not have enjoyed the *hundreds* of favorable comments I have received whenever I have changed square-cornered screens to round-cornered ones. More emphatically, let me add that, whenever I would reverse the process to see what the reaction would be, patrons would *without exception* request restoration of the round corners.

I discussed this subject in IP.* The

* "Psychological Elements in Projection"; IP for May, 1949, p. 14.

screens I advocate were illustrated therein and directions given for the preparation of the masking. *Any* projectionist can prepare this screen, since I have nothing to sell except an idea. I have no financial interest in any screen, equipment, or motion-picture process, hold no "rights" or patents, and receive no royalties. My position is that of the average projectionist who takes a keen interest in the welfare of the movies because the movies mean a livelihood.

In case my ideas sound extravagant, I refer interested parties to an unsolicited "Letter to the Editor" on page 22 for August, 1949, of IP in which occurs the statement:

"We are using rounded screen corners now and we can say that they encompass every advantage claimed for them by Mr. Mitchell."

Added Emotional Values?

Regarding the Schlanger-Hoffberg quote: "The maskless screen is described as 'cheerful — natural — scenic — better color.'" A whole chain of arguments could be started over these descriptives. Certainly, the imposition of emotional values on motion pictures by screen manufacturers might lead producers to think that their product is being tampered with, especially in those cases where the production of those values was a coldly automatic process, entirely beyond the control of the projectionist or other person who understands the "feel" of a picture. We do not want a "cheerful" screen when scenes of shipwreck, disaster, or battle are being projected.

The adjective "natural" is a little hard to swallow. Extraneous surround light was not present in the original scene, so why should it be called natural? "Scenic?" Perhaps. But phantasmagoria seems out of place during a tense emotional scene. "Better Color?" Well, let's analyze that one.

Effect on Color Films

I have written a number of articles on color motion pictures and have mentioned Technicolor and Dr. Kalmus, General Director, quite frequently. This a liberty on my part, of course, because I am not authorized to speak for Technicolor: I have no connections whatever with Technicolor or any other processer of natural-color films. In view of the existence of two distinct phenomena—the reflection of light from the Schlanger surround "wings" and the induction of simultaneous contrast in the psycho-visual centers of the viewer, I state without qualification that Technicolor, Anscocolor, Ektachrome, Trucolor, Cinecolor, *etc.*, undergo no improvement whatever when projected on the Schlanger setup.

Reflection may either intensify or weaken colors on the screen, depending on the distribution of colored areas in the picture. Simultaneous contrast may cause either the colors on the surround or the colors at the very edges of the picture to tend toward their complementaries, weakening the colors or producing spurious colors in areas of low saturation.

The Requisite for Color

I also take issue (in unsolicited behalf of Technicolor) with Schlanger's assertion that the "color boys" have never bothered to give projection conditions a passing thought. Apparently Technicolor's printed instructions to projectionists and exhibitors, given wide circulation a few years ago, have never come into the hands of Schlanger. The production people, including the cameramen and the "black-and-white boys," take projection conditions most seriously, even though they have not conspicuously interfered with the projectionists department. I reside in a community visited frequently by top-notch producers and cameramen, with many of whom I have discussed a wide range of motion picture topics, and therefore feel quite secure in making certain estimates of the worth to the industry of quite a number of things.

It is gratifying to know that Schlanger has conducted tests anent the reflections to the screen surface of light picked up and reflected back by the surrounds. Unfortunately, he produced no figures to support their claims—figures of interest to all projectionists.

"Wing" Material's Composition

My own tests to which I referred include both matte and specular materials, as well as flat and fluted construction of the surround wings. In fact, I could use many types of materials which Schlanger cannot use because of their commercial impracticability. Why did it require years for Schlanger to find the proper commercial materials? Semi-specular resin coatings of a wide variety of physical and chemical properties have been available for many years.

The writer's opinion is that Schlanger's wings are not as specular as they ought to be for the best results with the type of effect his screen surround is designed for. To contradict him flatly, unless his wings are highly polished mirrors (which they are not) a really appreciable amount of back reflection to the screen must occur—perhaps 8% over the brightness of a uniformly illuminated screen at the sides, and about 3 or 4% at the center. I challenge Schlanger and Hoffberg to go on record by publicly refuting the general validity of these figures with their own setup.

I commend to exhibitors a trial of the Schlanger maskless screen, so-called; I say "so-called" because the screen is really masked, but with fluctuating illumination instead of with a total absence of extraneous light. For many city houses this novel screen may prove just the thing to keep the clientele happy for a time. I do not recommend any type of illuminated surround for small-town and neighborhood houses except possibly for the showing of short-subjects only. I base this recommendation upon my own experience of public preferences, fully realizing that many different classes of persons like the movies.

Psychological Factors Involved

There is a psychological factor involved in all attempts at illuminated screen surrounds. The continuance of these atempts, despite their lack of acceptance in the average location, despite their unavoidable extension of 48-cycle flicker to the highly sensitive peripheral region of the eye, as in the Schlanger setup, and despite the conspicuous appearance of flatness they impart to the projected picture, leads me to believe that these are subconscious attempts to enlarge the picture, or viewing, area.

We want larger pictures, and the illuminated surround is merely the concrete manifestation of a desire which our 35-mm film, long-focus lenses, and inadequate arc-lamps—not to speak of peripheral flicker—do not allow being fulfilled at the present time.

'IN THE SPOTLIGHT'

The "In the Spotlight" department is necessarily omitted from this issue of IP due to the illness of its editor, Harry Sherman. Now recuperating, Mr. Sherman, it is hoped, will be able to resume his departmental chores in time for the next (March) issue.

IP Question & Answers

From time to time IP receives queries relative to various phases of the projection process, visual and sound, which the correspondents request be answered in a forthcoming issue or on a *sub rose* basis by direct mail.

IP holds that for the greater good of its subscribers such questions—stemming as they do from practical experience in daily operation—should receive the widest possible circulation. To this end, therefore, IP proposes to inaugurate a Question & Answer Department as a regular monthly feature, in which will be answered any and all questions on any phase of visual and sound reproduction. Anonymity will be preserved, with not even initials of the correspondent being used.

The value of this department is dependent wholly upon the degree of response from the field. So—the rest is up to you. You ask—we'll answer.

BUY U. S. DEFENSE BONDS

Genarco's New, Long-Burning H-I Carbon Disc Arclamp

OPERATION for several hours without interruption of the arc, and a very great brightness of 1800 candles per sq. mm. are two outstanding features of a new high-intensity carbon arclamp which has been developed by Genarco, Inc., of Long Island City, N. Y.

The arc is struck between an 11-mm positive carbon and a graphite disc which is 8 inches in diameter, as shown in Fig. 1. The current is 200 amperes. The lengths of positive carbons are supplied by a magazine which automatically joins the carbons so that there is no interruption of the arc.

Operating Principle of Disc

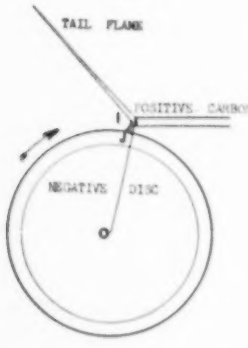
The negative disc rotates very slowly around its center, thus consumption is very slow. The initial 8-inch diameter of the disc is reduced to 5 inches after 20 hours of operation. The disc is 6 mm thick. The positive carbon is held by water-cooled jaws which also feed the current to the carbon. The current is fed to the center of the negative disc. As the disc wears down (and its diameter decreases) the center of the disc moves slightly toward the arc in order to maintain the same gap between the disc and the positive carbon.

Precise Arc Gap Maintained

One motor drives the feed mechanism of the positive carbon, rotating the carbon and feeding it into the jaws. The same motor also drives the magazine which feeds the carbons and joins them together. Another motor rotates the disc at the proper speed in order to maintain the arcing point on the disc at the point *I* (Fig. 1) on the line which joins the center of the positive carbon to the center of the disc. The same motor lifts the center of the disc in order to maintain a constant arc gap (distance *I—J* in Fig. 1).

The rate of feed of the positive carbons and the rate of rotation of the negative disc are automatically adjusted by

FIGURE 1



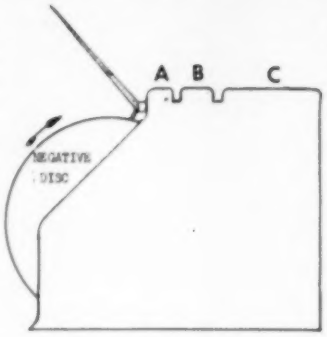


FIGURE 2

the location of two electric probes in the flame of the arc. The protrusion of the positive carbon out of the positive jaws is maintained with a precision of 0.025 inch.

The brightness of the positive crater measured in the axis of the positive carbon has been found to be 1800 ft.-candles per sq. mm. The arc is operated at 200 amperes at 80 volts.

This new burner (designated by the manufacturer as Model P. 1 and shown in Fig. 2) was developed primarily for military applications, but it is already apparent that it will be used where very bright and very small sources of light are necessary, such as powerful spotlights, color theater Tv, lighting for high-speed cameras, etc. Further details of the arc are available from Genarco at 36-56 Thirty-Fourth St., Long Island City, 6, New York.

Conservation—Plus!

Every theater in the U. S. and all IA projectionist Locals have received copies of the following conservation bulletin issued by the MPA motion picture section, Nat Golden, director.

Film supply is TIGHT—so tight that every effort must be made to conserve supplies.

REDUCE NEEDS FOR REPLACEMENT FOOTAGE BY AVOIDING DAMAGE IN THE PROJECTION ROOM

A recent investigation shows that most of the damage to prints is caused by:

IMPROPER THREADING AND OPERATION OF PROJECTORS

Much film damage has been traced to film improperly placed on sprocket teeth . . . improperly adjusted and aligned idle rollers . . . excessive gate tension . . . badly aligned guides . . . jammed magazine fire trap rollers . . . excessive tension in feed and takeup magazines . . . projector loops too small or too large . . . excessive emulsion deposits on gate shoes and guides and oil deposits on film.

IMPROPER REWINDING OF FILM

Half of all film damage is caused by improper rewinding. Faulty rewinding usually results in total loss of the print by destroying edge areas that cannot be repaired. Avoid film waste by making sure that you—

REWIND EVENLY AND SMOOTHLY
ALIGN REWIND HEADS PROPERLY
DO NOT "CINCH" FILM TIGHT

BLISTERING

Severe blistering of film is much too frequent, particularly in Drive-In Theaters and other places using projector light sources of very high amperage. Building up excessive light has resulted in the destructive blistering of emulsion on safety film prints and the total destruction of nitrate film prints.

Avoid film blistering by—

Making a careful check to find the danger point in the concentration of your light source.

Constantly checking all film and gate cooling devices to make sure they are operating properly.

Not changing the assembled arrangement of crater, condensers and reflectors unless you are sure that you know what you are doing.

BAD SPLICING AND SPLICING EQUIPMENT ADJUSTMENT

Run-offs, breaks, and other difficulties that ruin picture quality and shorten the life of prints inevitably result from poor splicing methods and improperly adjusted splicing equipment.

Remember when you are splicing to—

Use the proper kind of fresh cement.

Scrape the film properly.

Have your splicing equipment adjusted perfectly.

Allow enough hold-down time for the cement to set.

Movies Aid Canadian Cancer Drive

The Canadian motion picture industry has made itself a valued ally in the crusade to control cancer, according to the Canadian Cancer Society. The industry in Canada has made it possible for the Society to report directly to the theater-going public the significant developments in the cancer program each year.

Prints of a color film were sent to film exchanges throughout Canada. It is conservatively estimated that at least two million people have seen it. Its success has assistance of the motion picture industry, been made possible by the cooperation and particularly Canadian theaters

Cooling Means: A European Viewpoint

Stemming from the publication in IP for Nov., 1951 (p. 5) of "The Trail of the Elusive Screen Lumen," by Charles Hahn, is the appended discussion of the type and arrangement of glass filter strips in order to decrease the heat on the film.

By PAUL SCHANZ
Zurich, Switzerland

IT WOULD seem that most of your American equipment manufacturers are a bit one-sided on the subject of cooling methods for cinema projectors. Having at last recognized the importance of the heat problem, they do not seem to know what to do about it.

To be specific: Dr. Kolb of the Eastman firm, Mr. Davee of Century Projector, and Mr. Hahn of McAuley (Peerless arclamps), disagree among themselves as to the most effective means for maintaining both the film and the projector mechanism at reasonably low temperatures for the avoidance of damage. Dr. Kolb advocates air-cooling of the film, Mr. Davee water-cooling of the film "gate," and Mr. Hahn the use of heat-absorbing filters between the lamp and the mechanism.

It seems to me odd that each of these technologists deprecates the particular methods advocated by his colleagues without pausing to reflect upon the other fellow's viewpoint.

The Case for Heat Filters

Heat filters may be good if thye are kept clean, but I am unable to understand why costly quartz plates or easily damaged interference coatings are regarded as necessary by so many American projection men. Very good optical glass filters are probably available in the U. S. A. as elsewhere (correct me please if I am wrong). Jena heat-absorbing filters had been developed to supreme perfection before the end of the war. Projectionists wishing to use heat filters could choose from several types; but to my knowledge no one entertains the false notion that *all* the radiant heat is done away with when all intra-red is absorbed by a filter. Visible light accounts for a large portion of the heat evidencing itself at the picture window and film runners.

One Filter of Proper Thickness

I should like to be informed as to the basis of Mr. Hahn's frequently repeated statement that studio background projection and theater projection problems are totally different and unrelated. Mr. Hahn's figures for light-loss occasioned by heat filters are no less mystifying.

Because good Jena heat-absorbing filters are listed as transmitting 98% of visible light, it is obvious that the loss of light is essentially a loss due to reflection from surfaces, and not a loss caused by absorption. Why did Mr. Hahn not recommend that only *one* filter glass of the proper thickness be used, instead of a holder which permits the insertion of as many as 6 filters? Mr. Hohn must surely be aware of the fact that the spectral absorption characteristics of several thin filter glasses placed together is exactly the same as that of a single correspondingly thick glass having only 2 surfaces to waste light by reflections. This behaviour of filters is an established law of physics and is not subject to personal opinion.

A Jena filter glass suitable for the reduction of heat in the cinema projector transmits 98% of the visible light and reflects about 5 or 6%, resulting in a total loss of only about 7%. Like Mr. Hahn, I cannot comprehend the reason for an absorption so high as 20% of the light; but also I cannot understand his statement that as much as 14% of the light may be lost when filters are used. Are such great light losses tolerated in American projection practice?

It is possible that a misunderstanding of some kind has arisen, unless Mr. Hahn refers to reflective-coated glasses which, as pointed out by himself, are impractical in use because of the deterioration of the coatings.

High-Velocity Air Stream

High-velocity air stream apparatus costs very little whether incorporated in the projector or added to a non-cooled mechanism of the standard American type. Projectionists who have used this effective method with powerful Beck arcs (high-intensity) laugh at persons who think that expensive compression pumps, cooling units, or complicated pipe-work is involved; such thinking is beyond their understanding.

It is possible that the joke is on your projector manufacturers? How come that you Americans feel that you must practically *blast* the film with air under terrific pressure? It is wholly and completely unnecessary, as several of the European projectors make known.

Over-all Effect Very Good

While cooling by air and water flow do not directly reduce irradiation effects, such methods definitely cool the film by conducting heat away from the edges, which otherwise would get very hot. The powerful arc rays then have difficulty warping and otherwise inflicting damage on the film—a matter of thermal conduction. In addition, the air-flow cools the emulsion, thereby reducing the overall heating and permitting the projectionist to throw bright, clear pictures on the screen.

My friends and I enjoy INTERNATIONAL PROJECTIONIST very much and consider it indispensable to projectionists. It covers the projection field impartially, giving publicity to a wide range of new developments and furnishing information of great practical value.

In Rebuttal

McAULEY HEAT-FILTER UNIT

By CHARLES HAHN
J. E. McAuley Manufacturing Co.

THE comments by Mr. Schanz are most interesting, even though, to my mind, they miss by a wide margin the salient features of my article. True, there do exist disagreements between American manufacturers as to the most effective means for cooling both the mechanism and the film, but the writer feels that this topic is not a matter of prime importance in this exchange of views.

Regarding the writer's preference for the heat-absorbing glass filter system, it would seem that Mr. Schanz also approves of such methods, thus leaving us on common ground. Apparently, Mr. Schanz has misinterpreted the method we employ in utilizing these glass filters —which may be the writer's fault in not giving a more clear word-picture of the setup. Mr. Schanz states:

Arrangement of Filters

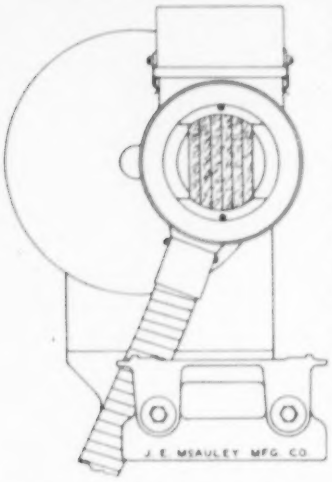
"Why did not Mr. Hahn recommend that only one filter glass of the proper thickness be used, instead of a holder which permits the insertion of as many as 6 filters? Mr. Hahn surely must be aware of the fact that the spectral absorption characteristics of several thin filter glasses placed together is exactly the same as that of a single correspondingly thick glass having only 2 surfaces to waste light by reflection."

The writer stated in his article:

"A filter glass unit consists of a metal frome with provision to hold a total of 6 strips of filter glass, each ½ x 4 inches and only 1½ mm in thickness. The strips are removable so that only as many need be interposed in the light beam as are required to prevent film damage at the particular current drawn at the arc."

Comparing these two statements, I believe it is apparent that Mr. Schanz misinterpreted my statement to mean that we insert 6 *separate* sheets, discs, or pieces of filter glass (one in *front* of the other) in a vertical position, and that each piece of filter glass was of a

THE McAULEY HEAT-FILTER UNIT



size that completely encompassed the light beam; also, that in order to obtain the adjustable feature, we removed one or more of the flat pieces or disc from the light beam.

How the Filter Unit Works

This is, of course, a misconception. The appended excerpt from a description of our Heat Filter which appeared in the SMPE *Journal* for May, 1948 (pp. 499, 500) is probably a more accurate description of the method we employ:

"The main frame of this heat filter attaches to the rear face of the rear shutter housing of the projector mechanism and provides the enclosure into which fits the frame for the filter glasses. The glass frame is supported by ears at its top, with ample room between all sides of it and the main frame inner walls to permit free passage of the air blown into this compartment from a centrifugal electric flower.

"There are 6 filter-glass strips used, each strip being approximately 1½" wide. They mount in their holder vertically and in a staggered relationship to each other. Hence the air stream from the blower may pass completely over all surfaces as well as the edges of each strip of filter glass, and, in consequence, efficiently radiate the heat each glass strip absorbs from the light."

Defends American Glass Quality

Mr. Schanz also seems to be trying assiduously to sell us on the superiority of Jena filter glass. Judging on the basis of any transmission charts that the writer has been able to obtain, it does not appear that Jena glass is any more efficient than the American-made phosphate type of glass; moreover, from a practical standpoint, the manufacturer of Jena glass would not be as good a source of supply as our domestic source.

We of the motion picture industry (and I believe I can speak for the American filter glass manufacturers) are well aware of the fact that the behavior of heat-absorbing glass is not subject to individual opinion.

Field Test Results Count

The light loss figures cited by the writer are those documented by tests made in the field under good, bad and indifferent operational conditions. Specifically, no consideration was given to figures made under laboratory control, for the simple reason that actual field usage does not permit results as efficient as those possible in the laboratory. Consequently, laboratory figures are misleading when compared with actual performance data gathered in the field.

The accompanying drawing illustrates clearly the method of mounting and using our heat-absorbing glass strips.

Plan a Stereo Feature Picture via 'Natural Vision' Process

Reports from Hollywood have it that Arch Oboler, noted author and director, will start work soon on a "three-dimensional" film which will utilize the so-called Natural Vision process for both taking and showing. This process was the topic of a report in these pages some months ago.* The process works like this:

In this system, two cameras are mounted on a common base and synchronized with each other. The film from the camera on the left records the picture approximately as it is seen by the left eye; the film from the camera on the right records the picture approximately as it is seen by the right eye.

A print is made from each negative, and the two positives are then run side-by-side on two synchronized projectors, each of which has a polarizing filter over its lens. When projected on a silver screen and viewed by the naked eye, these two films look like a double exposure. But when viewed through polarizing spectacles, the two pictures are unscrambled and the result is a three-dimensional picture which recreates the impression of the depth which could be seen on the set itself as it was being photographed.

This is essentially the three-dimensional system which was employed by Jack Norling about a dozen years ago with notable success,† and again last year by the producers of the three-dimensional movies shown at the Festival of Britain.††

It is announced that such a film may be shown in "any two-projector theater;" but this statement is true only if the length of the proposed feature—and "feature" was the word used in the news release—is of such length as may be accommodated by the projector magazines and the carbon trim. Should a change-over be dictated by the length of the feature, four projectors would be required.

Any theater which does not want to use such a feature in three-dimensional form may use it in conventional two-dimensional fashion.

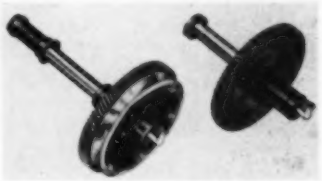
* "Natural Vision,' Latest 3-D (?) Entry; IP for August, 1951, p. 14.

† "Stereoscopic Motion Pictures"; by J. A. Norling, IP for August, 1951, p. 12.

†† "Projection in Britain's 'Telekinema'"; IP for October, 1951, p. 11.

New LaVezzi Intermediate and Main Drive Gear Assembly

A newly designed intermediate and main drive gear assembly for standard and Super type projector mechanisms has been introduced by the LaVezzi Machine Works, No. II. The new unit, part No. RK-107, features both gears revolving on stationary studs. The fixed studs absolutely eliminate the troublesome leakage of oil into the film compartment and soundhead from these two points.



LaVezzi's new intermediate and main gear drive conversion assemblies.

Longer life of the parts is accomplished through wider-faced and therefore stronger gears, the hardened steel intermediate gear, greater bearing area, larger shafts, and generally more efficient design. Costly bind-ups are minimized by the use of oil cups in the ends of the shafts and oil wells where lubrication is most needed.

The manufacturer supplies complete installation instructions with each unit. For further details address LaVezzi at 4635 West Lake St., Chicago 44, Ill.

For Uncle Sam—& *YOU*

SAVE EVERY OUNCE OF COPPER

FILM-COOLING MEANS

(*Continued from page 6*)

hotter as the gate temperature increases. The increase slowly attains a certain maximum level beyond which it never goes.

The additional fact that film having dye images (Technicolor) suffer little from irradiative effects and yet wind up almost as warm as an ordinary black-and-white film is also indicative of conductive heating. (Dye images transmit infrared rays instead of absorbing them as a silver image does.)

'Conductive Heating' Inclusive Term

The term *conductive heating* is more inclusive than it may seem at first thought. It includes, for instance, the *radiation* of heat (invisible infrared) from hot metal parts to film which comes into close proximity with, but does not actually contact, those parts. Accordingly, film exposed to the "black heat" of a hot aperture plate or light shield gets hot in exactly the same way that one's hands can get hot by holding them over a stove without actually touching the metal.

Conductive heating is banished by water-cooling the gate, just as in the Ernemann. It is interesting to note, however, that velvet film runners are supplied with the Ernemann. These are intended to be used only with new prints, especially unwaxed ones, in order to avoid "sticking" and the attendant evils of jumpy pictures, emulsion deposits on runners and tension shoes, and torn sprocket-holes. Many projectionists, however, use the velvet runners with all prints as a matter of course, claiming that their use provides an additional safeguard against conductive heating. (As if that were necessary with a gate already cold!)

Irradiative heating effects depend only on the radiant energy output of the arc-lamp and the length of time each frame of given area is flashed, or exposed, to the light. Conductive effects (including "black" irradiation) depend on the length of the gate, the temperature of the gate parts, their thermal conductivity, and the length of time any part of the film remains in the gate.

German Conditions Different

German projectionists are divided in their opinion of glass heat filters. On the whole, they are indifferent to them. "The Ernemann," argue the rank and file of German projectionists, "simply does not need heat filters. Why throw away 5 or 10% of your screen illumination when the mechanism and film are cooled satisfactorily by air and water methods?"

While filters *are* used with many

Clear Crisp Pictures with
SUPER SNAPLITE
f/1.9
PROJECTION LENSES

Your patrons will notice the difference! Super Snaplites give you Sharper Pictures, More Illumination, Greater Contrast and Definition.

For the Best in Projection use Super Snaplites . . . the only Projection Lenses to give you a true speed of f/1.9 in every focal length up to 7 inches.

Ask for Bulletins 207 and 209

KOLLMORGEN *Optical* **CORPORATION**
2 Franklin Avenue
Brooklyn 11, New York

"YOU GET MORE LIGHT WITH SUPER SNAPLITE"

Ernemann installations, this common argument is perfectly valid from the standpoint of the average German projectionist's working conditions. His theater is small, and his screen is amply illuminated by a low-amperage, high-intensity arclamp. But the writer cannot help thinking that experience in an American drive-in employing 170-amp arcs would quickly convince him that air-cooling of the film is not in itself sufficient to combat the *highest* intensities of irradiation.

As the writer sees it, the necessity of using a heat filter—just *one* glass of the proper thickness and a blower to disperse absorbed heat—is an inescapable conclusion when the big babies of the arclamp family are used. In fact, the writer thinks that projectionists in the smaller theaters would actually gain light by throwing away those Pyrex pie-plate draft-deflecting glasses and using high-quality-infrared-absorbing filters in place of them.

Single Filter Advocated

Why should only one filter glass of the proper thickness be used? Simply to avoid unnecessary surface-reflection losses. These losses, far more serious than light-absorption losses *inside* the glass, can be further minimized by optical anti-reflection coatings.

The Ernemann X deserves above all other theater machines the epithet "cold projector." This projector is worthy of the closest study. If the top-notch American projectors now available had incorporated into their *basic* design the *combination* air and water plus filter cooling, the Ernemann would certainly have to share its chilly throne with at least four other mighty good projectors.

But so long as one manufacturer insists that filters are the only solution of the heat problem, and another that air-cooling alone is effective, and yet another that nothing at all except water-cooling is of any use—then the heat problem still will be with us, ever and anon.

Photography Comes to America

The daguerreotype was born on Monday afternoon, August 19, 1839, in Paris. On that day the French Academy of Science, acting under government orders, held a special meeting to furnish the public with full instructions for making daguerreotypes. The secret had been purchased for the common good from the inventor, Louis Jacques Mandé Daguerre.

Just when the first photograph was made in the United States has long been a matter of conjecture. Samuel F. B. Morse, in the New York *Journal of Commerce* for September 28, 1839, stated that "the merit, I believe, belongs to Mr. D. W. Seager of this city, who has for several days had some results at Mr. Chilton's on Broadway." The exact date can now be established. The George Eastman House has acquired a letter from Seager to the manager of the American Institute, stating that he is sending to the Institute, for preservation, the daguerreotype which he took in New York City on September 16. Unfortunately, it is not known what has since happened to the daguerreotype.

There is a picturesque story, related by the brother of George W. Prosch, a pioneer photographer in America, that just as the ship in which Seager was sailing from London was leaving the dock, a friend threw him a copy of Daguerre's instruction manual. Was it this choice, by a nameless friend, of a bon voyage gift which brought photography to America?

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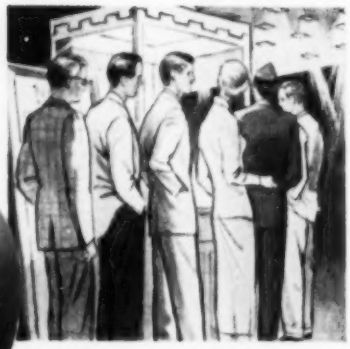

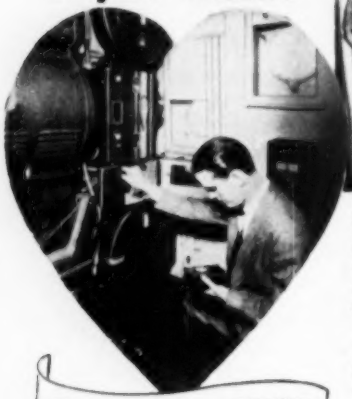

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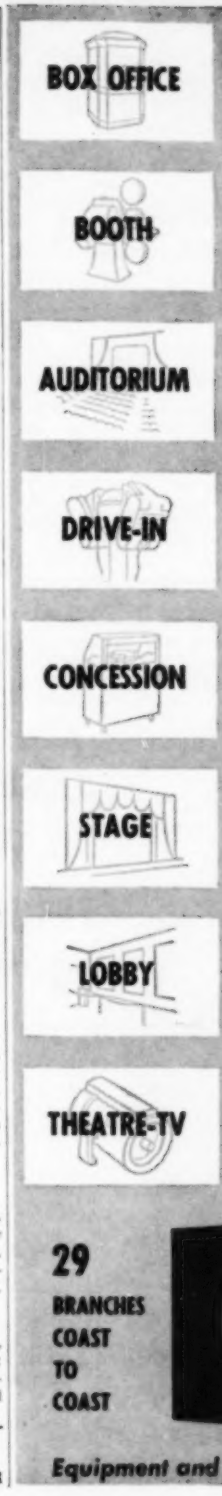

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New RCA Service Co. N. Y. Quarters

The New York district office of RCA Service Co. technical products division has moved to new quarters, at 155 East 24th Street, New York 10.

RCA Service Co. has singed a contract with Kallet Theatres, Inc., to provide sound service and parts replacement for 23 of the circuit's houses in New York State.

Glaser Promoted by IPC-Simplex

Appointment of R. S. Glaser as assistant sales manager of International Projector Corp., makers of Simplex X-L visual and sound projection equipment, has been announced by Arthur Meyer, sales manager. Glaser joined IPC in 1935 and has served in various capacities throughout the plant, including as an active member of the production control department. In 1946 he was transferred to the sales department, serving there until his present appointment.

W.E. Newsreel Recorders for Air Force

Wright-Patterson Air Force Base, Air Material Command, Dayton, Ohio, has acquired from Westrex Corp. 23 Western Electric single-film newsreel recording systems with accessories. Each of these W. E. 235-D newsreel recording systems consists of microphones, amplifier-noise reduction unit, power unit, modulator, and interconnecting cables.

Features of these compact, light-weight, rugged systems are film noise reduction, low impedance moving-coil microphones, magnetically-sealed light valves, 100-mil standard density sound track, genemotor for plate supply, airplane-type storage battery power for system and camera.

Government Report

PB 102 294, *Research Directed Toward the Development of Acclimatized Silver Halide Film*, 66 pages including photographs, graphs and charts; sells for $8.75 in photostat, or $3.00 in microfilm form. Address orders to the Library of Congress Photoduplication Service, Publication Board Project, Washington 25, D. C.

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HEAT-TRANSMITTING MIRROR

(Continued from page 17)

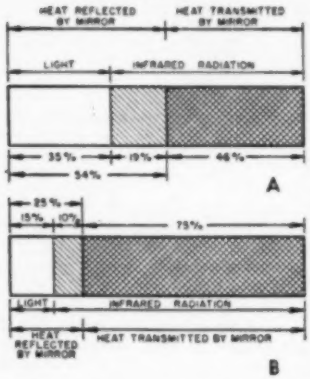

FIG. 6. Distribution of energy by reflection and transmission using heat-transmitting mirror: *A*, high-intensity carbon arc source; *B*, incandescent-lamp source.

transmits more than two-thirds of the unwanted heat due to infrared radiation. It transmits nearly half of the total radiation with a loss of less than 10% of the visible light.

When used with an incandescent source, the performance of the heat-transmitting mirror is even more impressive. In this case, 75% of the total energy of the lamp is transmited through the mirror with a loss of less than 10% of the visible light.

A gas-filled incandescent lamp operating at a color temperature of 3000 K radiates about 15% of its energy in the visible spectrum between 400 and 700 mμ. Nearly 85% of its energy is radiated in the infrared region between 700 mμ and infinity.

The second chart in Fig. 6 shows how the heat-transmitting mirror performs when the light source is an incandescent lamp. About 88% of the unwanted heat energy due to infrared radiation is removed by the mirror. Seventy-five percent of the total heat energy is removed, with a loss of less than 10% of the visible light.

Various Arrangements Possible

The heat-transmitting mirror might be used in a number of ways to reduce the temperature of the film as it passes through the gate of a motion picture projector. Fig. 7 shows an arrangement in which multilayer films replace the usual silver reflecting layer on the convex surface of the reflector in a motion picture projector. The glass reflector shell, *C*, has its convex surface, *A*, coated with the evaporated films which transmit a large part of the heat and reflect most of the light.

A corrugated metal shell, *B*, encloses

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DENVER, COLO.—Nat'l Theatre Supply Co.
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NORFOLK, VA.—Norfolk Theatre Supply Co.
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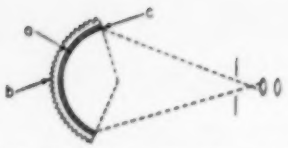

FIG. 7. Sketch of projection optics using a heat-transmitting film on back surface of reflector.

the back of the reflector and is spaced away from the evaporated films. This metal shell serves the double purpose of protecting the reflecting surface from contamination or mechanical damage, and absorbing the radiation so that the energy may be dissipated by convection currents.

One possible disadvantage of the scheme shown in Fig. 7 is that elaborate and expensive equipment might be required to evaporate thin films with the required uniformity on the convex surface of the reflector. This disadvantage would be overcome in the arrangement shown in Fig. 8. Here the multilayer film, *A*, is on the concave surface of the reflector where it would be relatively easy to obtain the required uniformity.

Protective Shell Utilized

In order to protect the surface from contamination and mechanical damage, a thin-glass shell is placed in front of the reflector and in contact with it all along the rim. This shell might be removed for cleaning, and it could be replaced when its concave front surface gets badly pitted by hot particles from the carbon arc.

FIG. 8. Projection optics using heat-transmitting film on front surface of reflector, protected by another glass.

Still another arrangement of the heat-transmitting mirror is shown in Fig. 9. The evaporated films, *A*, are placed on the back surface of a flat plate of glass, *C*. A thin, corrugated-metal housing encloses the back of the reflector and keeps it clean and free from mechanical damage. The heat is dissipated by convection currents of air flowing past the thin metal housing.

This arrangement, with a single heat-transmitting mirror and a normal silver-backed concave mirror, requires a right-angle bend in the illuminating system. If this is a disadvantage, it could be overcome by the use of two heat-transmitting mirrors like those shown in Fig. 9, arranged to make an offset system with two right-angle bends. This would result in a two-stage heat filter which would be even more effective than shown by the charts in Fig. 6. If desired, a two-stage heat filter could also be obtained by using a combination of the systems shown in Fig. 7 or Fig. 8 with the system shown in Fig. 9.

1. J. Strong, "On a method of decreasing the reflection from nonmetallic substances," *J. Opt. Soc. Am.*, *26:* 73-74, Jan. 1936.
2. C. H. Cartwright and A. F. Turner, "Multilayer films of high reflecting power" (Abstract), *Phys. Rev.*, *55:* 1128, June 1939.
3. G. L. Dimmick, "A new dichroic reflector and its application to photocell monitoring systems," *Jour. SMPE*, *38:* 36-44, Jan. 1942.
4. G. J. Koch, "Interference mirrors for

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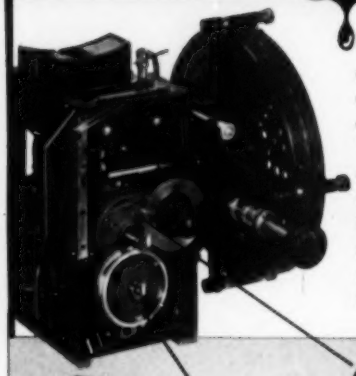

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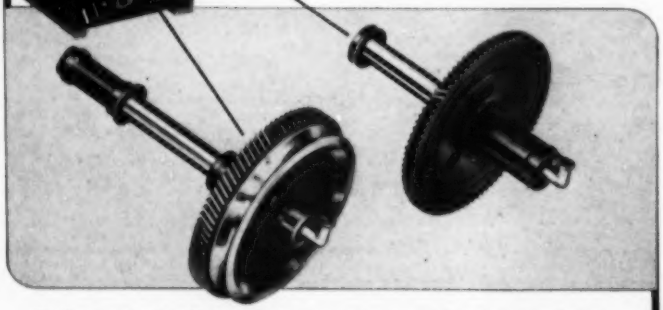

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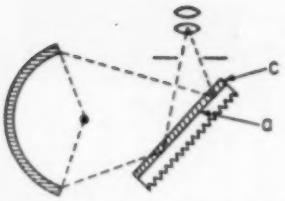

FIG. 9. Flat heat-transmitting mirror used in beams from silvered reflector.

arc projectors," *Jour. SMPTE*, 55: 439-442, Oct. 1950.

DISCUSSION:

Frank Carlson: What is the maximum temperature the mirrors will stand?

P. J. Herbst: No tests have been made to determine the maximum temperature the mirrors will stand. No damage has resulted from tests using the mirrors in the beam from a high-intensity arc.

D. B. Joy: Has it been found that these films will stand up satisfactorily in ordinary projection lamps used in motion picture projection?

Long Life Indicated

Mr. Herbst: The mirror has been subjected to the beam from a high-intensity carbon arc, focused to about a 3-inch diameter spot, for several hours without damage. However, actual life tests have not been made on the mirrors.

Mr. Joy: The motion picture industry should be grateful to you people for having done some work along these lines. We are faced with a very practical and immediate problem of trying to keep the heat down on the film, while we are trying to force a great quantity of light through the film in outdoor theaters. Therefore, anything along this line, coming at this time, will be of great help in giving us better movies, and that's the thing we want.

Mr. Strickland: If you don't have the shield in front of the mirror, and you get pretty well pitted, does that have the tendency to lower your light?

Mr. Herbst: You mean the dichroic on the front of the mirror next to the carbon arc?

Mr. Joy: Thats right.

Mr Herbst: This would not be recommended. The dichroic surface should be protected.

FILMING 'QUO VADIS'

(*Continued from page* 12)

tremely well done. The photography of this sequence is one of the highlights of the picture.

The 'Blue-Backing' Method

Several important scenes called for background projection; but as we had no equipment for this, the scenes were accomplished by employing the "blue-backing" method introduced by Tom Howard, of M-G-M's London studio. His method of photographing and combining in the printing of background and foreground action is said to be the best in the industry. As an example of how this method was used to make a composite scene showing Robert Taylor driving a fast chariot, without having to do this from a travelling camera car, we made a running background shot in the same manner as we would for a normal background projection shot. Then Taylor, in a chariot, was placed before the camera, with a blue backing, brightly lit, behind him, and his action of driving the chariot was photographed.

Back in London, Tom Howard combined the two negatives in optical printing to achieve the pictorial effect desired. Those who have seen this footage on the screen marvel at the great depth of focus and quality achieved.

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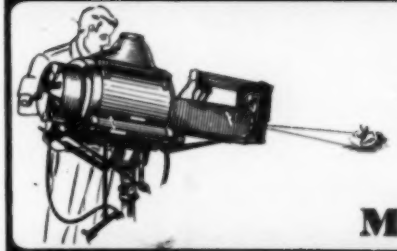
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day foreground action, we achieved a smooth overall 750 candles; the secondary shot of the foreground action was then lighted for the same level. Where a night effect or low key effects was desired in a blue-backing shot, the backing was lighted as for day shots, *i.e.*, 750 candles, and the foreground action level was reduced to 400 foot-candles. A register and definition chart was photographed before each take.

Tremendous 'Extra'—Task

Recruiting and directing the tremendous crowds of extras that were used in the picture is a story in itself. Costuming and making up 14,000 extras was not child's play. Finding this many Italians and getting them on the set was the task of Mel Ballerino, sent over from Hollywood to supervise casting. There was no "Central Casting Bureau" in Rome to which Ballerino could telephone his requests for extras. So great was the picture's cast requirements that a large segment of the Italian population had to be recruited for the picture in a most novel way.

Italian motion pictures have been noted for their large mob scenes. Instead of central casting offices, there have come into existence in Rome men skilled at getting mobs of Italian people to work in films. These men are called "Capo Grupos"—group captains. To get mobs of extras for "Quo Vadis," casting director Ballerino would contact the Capo Grupos, who would then canvass their neighborhoods or their lists and round up the required number of people needed for the next day's shooting. It was the Capo Grupos' responsibility to see that their respective groups arrived at the set or location on time and ready to work.

The people under each Capo Grupo's jurisdiction were given a sleeve band having an identifying mark to wear. When preparing the extras for appearance in the mob scenes in Nero's Arena, our assistant directors had maps prepared showing the seating arrangement in the arena. Little markers with numbers had been placed in sections of the arena, and these sections were marked on the maps. Thus, each Capo Grupo would be given certain sections of the arena to fill, and he would direct his charges to the section marked with the numbers designated. It was a very efficient system, completely free of confusion.

When it came time to pay off the thousands of extras, the money was merely turned over to the Capo Grupos, who in turn paid off the people captained by them. The fine cooperation of the "Capos" and people alike resulted in many wonderful scenes.

A Laugh or Two, Too

As I look back on this assignment, many humorous incidents come to mind. I have to laugh every time I think how we had to send most of Nero's Praetorian Guard to the barber shop each day for shave. And then there was the situation that arose with the women dancers from the Rome Ballet. Before we could shoot the dance numbers in Nero's banquet scene, we had to send all 40 of the women to the barber shop to get the hair shaved from under their arms. Italian women just don't believe in such things!

One day, when on location, members of the Italian electrical crew were about to go out on strike because the unit manager had substituted bottles of Coca-Cola for the customary wine in their lunch boxes. On still another day, one of the fighting bulls broke loose, and chased everybody on the lot indoors. Not until a squad of police arrived in a jeep and armed with machine guns, was the rambunctious bull quelled in hilarious action reminiscent of the old Keystone Comedies.

One day we noticed that the horses drawing Bob Taylor's chariot seemed to have changed color. After intensive questioning of their attendant, it was revealed he had substituted different horses. Someone had offered him more money for the use of the regular team in a private funeral procession scheduled for that day!

These are just some of the lighter moments in the making of a truly great production—a production concerned with the teachings of a man who taught goodness and mercy and who was crucified almost 2,000 years ago. I consider it an honor to have photographed it.

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